Weatherwise

Nav Aer 60-35R-12

Topsy-Turvy Winter

The Meteorology of Avalanches - I

Comfortable Living Depends on Microclimate

Minneapolis Weatherball

American Meteorological Society

With the Reserves

Vol. 3, No. 1

FEBRUARY, 1950

"SOME PEOPLE ARE WEATHERWISE BUT MOST ARE OTHERWISE" — BENJAMIN FRANKLIN

WEATHERWISE

THE MAGAZINE ABOUT WEATHER

COPYRIGHT 1950, BY AMATEUR WEATHERMEN OF AMERICA

DAVID M. LUDLUM, *Director* — CHARLES A. FEDERER, JR., *Editor*
HANS H. NEUBERGER, *Technical Editor* — D. C. CAMERON, *Research Associate*
ERIC SLOANE, *Art Director*

TOPSY-TURVY WINTER

AFTER the coldest winter of record throughout the far Northwest in 1948-49, that region had every reason to expect (or at least hope for) something better in '49-50. Conversely, most of the East, which had enjoyed an unusually mild winter last year, expected something more closely akin to a normal winter. The Weather Bureau long range forecast unit saw fit early in the season to propose just that sort of turnabout; but unless something quite unusual occurs during the remaining weeks of winter, the die has been cast for a replica (with minor variations, of course) of the '48-49 variety of weather over the nation.

Chart I in *Weatherwatch* for December, 1949, indicated the now familiar temperature pattern of an above-normal East and a below-normal Northwest, but the first 20 days of January turned out to be one of the coldest such periods on record in the Northwest, and one of the warmest midwinter spells ever known in the East. At Seattle the 20-day mean was 26°, 13° below normal (the coldest January, 1916, averaged 31°); Portland averaged 28°, 12° below normal, only a bit less cold than record January, 1949; and Spokane's average of 11½° was only 3° above the whole January mean last year. East of the continental divide, Havre averaged −11°, or 21° below normal, but still not as cold as the whole month in 1916, −13°. In other respects January, 1950, was much worse than in 1949 in the Northwest. Whereas a year ago it was the driest on record at Seattle, Spokane, and Portland, this year the abnormal wetness was the outstanding feature accompanying the cold, resulting in unusually heavy snowfalls.

A violent blizzard raged over western Washington on Friday the 13th. To be sure, there had been higher winds (but probably never from the northeast); there had been heavier snows (Seattle in 1916 had 23″ in January and 35″ in February); and there had been lower temperatures; but never had the section seen the vicious combination of all three in the worst storm of a generation. For nearly two weeks before, the polar front marking the boundary between the intensely cold Arctic air of western Canada and less cold polar maritime air, that had kept western tempera-

(Continued on page 11)

Vol. 3, No. 1 — February, 1950

CONTENTS

Topsy-Turvy Winter 2
The Meteorology of Avalanches — I — Mary-Rebecca Cregar and Wilde R. Mellencamp 3
Comfortable Living Depends on Microclimate — H. E. Landsberg 7
Minneapolis Weatherball 10
American Meteorological Society 12
With the Reserves 15
Forecasting the Weather — The Relationship of Temperature and Precipitation over the United States to the Circulation Aloft — Donald E. Martin and Harry F. Hawkins, Jr. 16
Workshop for Weathermen—Charles A. Laird 20
551.5 22

Cover: A windslab avalanche, photographed by Dr. Paul Gut, chief of the Swiss Rescue Division. Reproduced from **World Ski Book**, edited by Frank Elkins and Frank Harper, by permission of the publishers, Longmans, Green and Co., Inc. (See page 3.)

WEATHERWISE is published bimonthly by Amateur Weathermen of America, Franklin Institute, Philadelphia 3, Pa. Membership in the AWA costs $3.00 per year, of which $2.00 is for a subscription to WEATHERWISE and $1.00 for general dues, for members in the United States and possessions and in the armed services. Add 50 cents per annum for postage to Canada and all countries of the Pan-American Postal Union; add $1.00 for all other foreign countries. Make checks and money orders payable to Amateur Weathermen of America. Send notice of change of address three weeks in advance, giving old address. General, circulation, and advertising offices: Franklin Institute, Phila. 3, Pa.

An explosive-induced small avalanche on a steep avalanche "chute" which normally would be subject to giant avalanches. Wasatch National Forest.

The Meteorology of Avalanches - I

MARY-REBECCA CREGAR AND WILDE R. MELLONCAMP
AMATEUR WEATHERMEN OF AMERICA

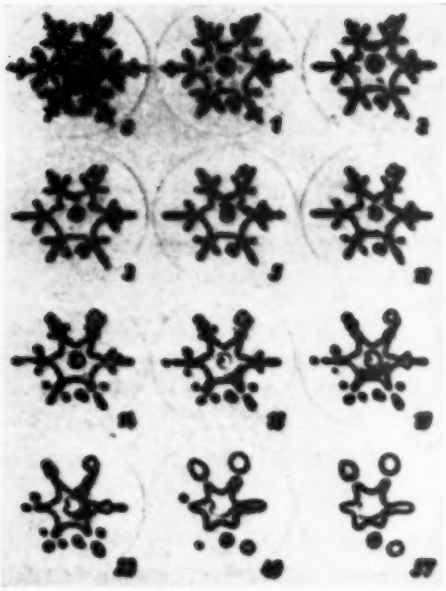
FLOODS AND FROSTS, hurricanes and droughts, all have plagued Americans since the days of the first settlers. But of all the children of the weather, the snow and ice avalanche has been the slowest in making itself felt and feared — for the simple reason that it took 200 years and a gold rush for pioneers to penetrate the rugged and threatening mountains of our West that breed avalanches.

Today those mountains are criss-crossed with railroads, highways, and power lines. And the areas are thronged by hordes of adventure-bound skiers, annually totaling over 100,000 at several lift areas. A booming winter trade keeps inns and lodges open the year round, so highway and railroad maintenance crews must remain on the job throughout the winter to keep this huge traffic moving.

The results are often tragic: "Two trainmen killed in avalanche." "Power lines down; highways blocked by slide." "Skier buried alive." "Mine operations halted by snow." These headlines dramatize the importance of avalanche precaution in the mountain country.

For a beginning in avalanche study we must turn to Europe. The pioneer in scientific research in this field is a German, William Paulcke, whose observations and studies in the late 19th century, carried on without benefit of extensive laboratory equipment, form the backbone of present knowledge.

Switzerland, lying in the heart of the European avalanche country, authorized in 1931



Successive stages in the aging of a snow crystal. The upper left shows a fully developed crystal, the lower right an aged crystal.

a commission for the study of snow and avalanches, and set up a research laboratory at Davos. As a result of its practical and theoretical work, a network of avalanche observation posts has been established. Post reports are relayed daily to headquarters, where they are plotted and analyzed in much the same manner as ordinary weather data are correlated. Forecasts of avalanche conditions are broadcast daily to an appreciative audience.

Since the establishment of this system, the Swiss have not had a single major avalanche disaster, although in neighboring countries as many as 20 men at a time have been killed when similar weather and terrain conditions existed.

An English skiing enthusiast, George Seligman, became interested in the subject of avalanches, and he has conducted extensive investigations of his own. His books now comprise the only thorough treatment of the subject in the English language, and have been collected in his valuable work, "Snow Structure and Ski Fields."

Since the field of avalanche study is so new in this country, it was only within the last year that an original American report appeared. "The Alta Avalanche Studies," published by the U. S. Forest Service, compiles the researches of M. M. Atwater, snow ranger at Alta, Utah, and F. C. Koziol, supervisor, Wasatch National Forest.

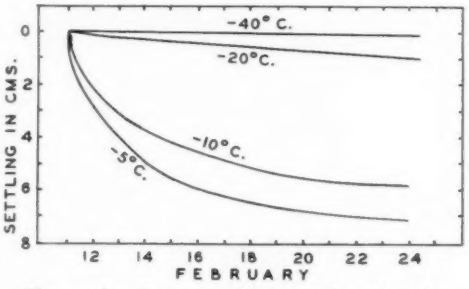
The conditions leading to avalanche danger are complicated and not of general knowledge. They are, however, completely dependent on meteorological factors, and thus should be part of the weatherman's education.

What causes an avalanche? In simplest terms, it is the result of unstable snow conditions combined with certain terrain conditions, or the ability or inability of a snow mass either to cling to a slope or to cling to another snow mass.

Stability is the chief concern of the weatherman, since it is governed by temperature, wind, and moisture conditions (humidity and rain). For an explanation of the influence of weather elements on stability, let us consider the life history of a basic snow crystal.

The common fully developed snow crystal has six branches extending from a nucleus, and these branches may be subdivided in the same manner. A new fall of snow has some cohesion at the contact points of the branches. As soon as these hexagonal branches start to disappear, the snowflakes become unstable and dangerous until sufficient change has taken place to bring the central nuclei into contact with each other, producing "settled snow."

Crystals can lose their branches in several ways: by sublimation, melting or wetting with rain, or wind action. Through sublimation the branches evaporate rapidly since they have a large surface area. The moisture thus released to the surrounding air recondenses on



The results of an experiment to determine the effect of temperature on the rate of settling of a mass of snow.

the nucleus with its small surface area. Thus the crystal loses all or most of its spicules and becomes a grain. The longer this process continues, the larger the grain grows, feeding on smaller grains and adhering to neighboring grains. With this rearrangement of material, the space required by each crystal becomes progressively smaller and the snow settles, becoming more dense and cohesive. In other words, the once unstable slope of snow becomes stable.

Temperature plays the leading role in determining the rate of settling. A mass of new snow kept at −40° C. in laboratory experiments showed no change in volume over a period of time. Another sample at −20° C. settled at an even rate of speed, producing a straight-line graph. Other samples showed that as the temperature was increased the initial settling greatly increased. Snow in the field has been observed to settle 50 per cent of its original volume within 24 hours.

When the temperature rises above freezing, the snowflake branches are lost through melting. The thaw water sinks vertically through the snowcover until it meets an obstruction — a hard-packed or iced layer, or the ground — and the flow is diverted valleywards. (Rain water acts in exactly the same way.)

What effect does this have on stability? Although the branches disappear and the snow mass becomes more dense, it does not gain cohesion. Rather, the free water forms a lubricating film around each grain, giving the mass a heavy, unstable character. Furthermore, the water "greases" the obstructing layer or ground and makes of it a sliding surface. The stage is set for a wet-snow avalanche.

If danger layers refreeze, conditions tend again to become stable, but it must be remembered that snow is a most effective insulator and that thaw water lubricates the lower layers of snow hours after a subzero snap has frozen the surface.

The temperatures preceding, during, and after a storm, as well as the type of precipitation, are of great importance. For example, if either wet or dry snow falls on a hard surface which has been softened by a rise in temperature or strong sunlight before the storm, then the new snow will adhere. Should, however, dry snow fall on a cold hard surface the adhesion would be very poor. Wet snow

The terminus of an explosive-induced "sloping" avalanche that crossed a much-used ski run in the Wasatch National Forest.

This car owner did not heed "No Parking" signs and the regulations on a highway leading to a ski resort. Note the avalanche damage to the side of the car. Wasatch National Forest.

tends to freeze to a hard cold surface. It goes without saying that poor adhesion between layers makes for poor avalanche stability.

Wind also plays a major part in avalanche danger. If the wind is strong enough to transport snow, wind slab is formed at the point of deposit. Slabs consist of rounded crystals cemented together (iced). They are brittle and can be broken by the vibration of a train whistle far down in the valley or by the weight of a small animal. Worst of all, they contain great latent danger. A slab not initially dangerous can become so with time if it rests on a layer of unsettled snow. The snow beneath will settle; the slab will not, and an air space can develop between the layers. A slight shock and the slab will break.

Wind too weak to transport snow may form wind crust, which is more annoying than dangerous to the skier if he keeps breaking through. There is much work to be done to learn exactly what takes place in wind packing. Both slab and crust have rounded crystals which are frozen together. The fact that this is true of both types of wind-affected snow has not yet been adequately explained.

A cornice is a special wind-built snow formation. It looks like a wave about to break over the lee side of a ridge. During its formation, the blown snow which does not go to build the cornice blows on over and drops just beneath on the lee side, forming a wedge-

(Continued on page 14)

High on this slope are seen the typical fracture lines of a slab avalanche in the Wasatch National Forest.

Comfortable Living Depends on Microclimate*

H. E. LANDSBERG

"YOU LIVE in Washington, D. C.; isn't it uncomfortably hot there in the summer?" This is a perennial question of all visitors. When they think of Washington's climate they refer to the center of town. They forget that Washington, as well as nearly all other big cities of the United States, includes really a great variety of climate in its metropolitan area.

The basic ingredients of the climate, that is, the unending sequences of air masses brought by the general circulation of the atmosphere into the area, are naturally the same. Yet from section to section of the big city these air masses are modified in their climatic effects by topography, natural vegetation, human modifications of the landscape, including buildings, houses, parks, and streets. These modifications are by no means negligible. They dictate the microclimate. This can be substantially different from what the official records of a Weather Bureau station may indicate as the climate of the city.

For the individual who wants to live as comfortably as possible, the selection of a home site is a very important step. This selection is usually dictated by such considerations as financial factors, schools, shops, and transportation. The criteria should include the microclimate, but most people hardly know that there is such a thing. Let's come back to the case of Washington, D. C. With an average of 101 days when the daytime maximum temperature at the downtown Weather Bureau station equals or exceeds 80° F., with 28 days, on an average, reaching or exceeding a maximum of 90° F., and 31 days with daily minima over 70° F., the summer heat is certainly an important factor to be considered for comfort.

The question is therefore: How universally representative are these conditions for the area as a whole? Even a very cursory survey will lead us to the answer that there are considerable variations throughout the metropolitan area of the city. We can back this statement up with measurements taken on a typically hot summer day. They were made with a specially shielded thermistor installed on a car. Readings were taken frequently on a 16-mile cross section from Fairfax County, Virginia, across the District of Columbia, to Prince George's County, Maryland. The data were used to plot an isothermal map for 1:20 p.m., in terms of temperature differences against the Weather Bureau station at the National Airport. The reading there was 93.5° F. Appropriate corrections were made for the difference in time of the various readings.

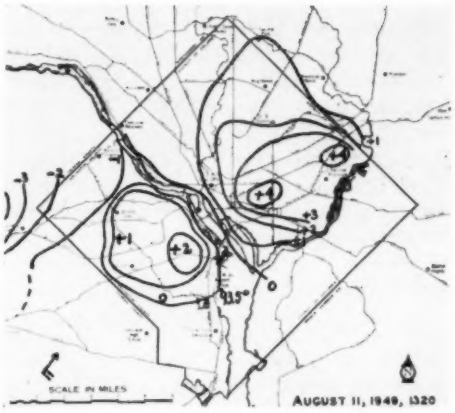


Fig. 1. Temperatures at 1:20 p.m. in Washington, D. C., and vicinity, August 11, 1949. The National Airport temperature was 93.5° F., as marked on the chart.

The results are shown in the accompanying chart. In the business section of Washington, temperatures were up to 4.5° higher than at the airport, near the Potomac River. In the built-up residential areas, the temperatures were 2° to 3° higher than at the airport, while in the open farm lands of Maryland the tem-

*Based on an address entitled "Microclimatology and House Building," presented before the First Annual Technical Forum of *House Beautiful*'s climate control project on September 20, 1949. See also issues of *House Beautiful* magazine since October, 1949, which contain interesting articles on the climate control project, a large-scale program directed toward more comfortable living.

peratures were about the same as near the river. In the hilly country of suburban Virginia, where the terrain rises up to 400 feet above the river, it was 2° cooler, and in the shade of some of the old oak forests of Fairfax County 4° cooler. There the heat was 8.5° below that in the center of the city. We can readily see that the stone and asphalt areas of the city have a different microclimate than the park areas near the river or the pastures, rolling hills, and forests of the suburbs.

Eleven hours later on the same day the measurements were repeated. At 10 p.m., some hours after sunset, under a clear sky a really calm summer night had descended on the metropolis. The outgoing radiation emphasizes the microclimatic differences even more. The second diagram shows the isotherms of differences against the official airport station. The city was still hot, 85° F., because of the radiation from the hot walls and streets. But in the open spaces of Virginia and Maryland it was some 4° cooler than at the airport, where the river smooths out the worst extremes of day and night. In some spots, where slight differences of elevation caused cool slope breezes, the development of shallow pools of cold air produced temperatures as much as 9° lower than at the airport, or 11° lower than in the city. That is just the difference between a sweltering evening and a comfortable summer night. These differences are typical. They develop, as comparative measurements over longer periods have shown, on nearly all clear days. This answers our initial question. You can live quite comfortably in the Washington summer, *if you select the right microclimate for your home site.*

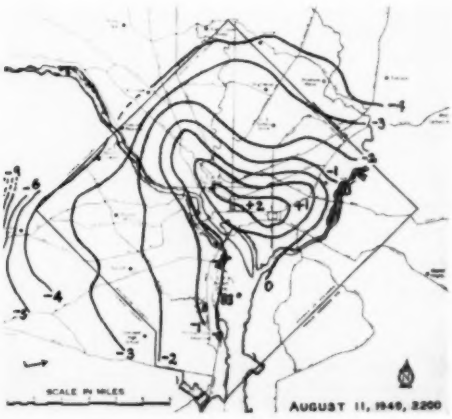


Fig. 2. Temperatures at 10:00 p.m. in Washington, D. C., and vicinity, August 11, 1949. The National Airport temperature was 83° F., as marked on the chart.

There is a price to be paid for this advantage. The bill is presented in other seasons. In the spring there are late frosts in the suburbs, and in the fall the frosts occur earlier than in the city. In winter more heat is required to keep your house warm. It is, however, easier to heat a home and to protect your plants from frost than to keep cool in a scorching summer.

In other sections of the country heat may not be the major climatic problem. Instead, we may be confronted with other undesirable features of the climate. It may be winter cold, strong winds, local air pollution, excess moisture or rainfall. In all cases a different type of microclimate will offer optimal conditions for the local circumstances.

Having chosen the house site with the best possible microclimate, there are many microclimatic changes which can be produced by landscaping. A slope flow of cold air, for example, can be dammed up by a hedge or wall to form a little lake of cool air for summer comfort. Or if we want to eliminate a frost pocket, we can accelerate the passage of cold air by eliminating obstacles to air drainage.

Hedges, trees, and park strips can have a very beneficial influence on the microclimate. For one thing, they always act as air filters and reduce dust and pollution products on the lee side. They also offer wind protection. This may have two other advantages. First, it will reduce the rate of evaporation of water and prevent desiccation of gardens. Second, it will reduce the cooling power of the wind, which is a function of both temperature and wind speed. A protective hedge or strip of trees to the side from which the coldest winds blow may result in substantial savings of fuel in winter. A dense strip of vegetation, about five times as wide as high, will reduce the wind speed just to the lee by about 70 per cent. At five times the distance of the height of the trees the reduction is about 50 per cent.

Even single trees may offer considerable shade, which has a most desirable microclimatic effect in summer. The following meas-

urements illustrate this. They constitute a typical example:

Air temperature taken under standard meteorological conditions	77° F.
Concrete walk in the sun	95° F.
Dark slate roof in the sun	110° F.
Short grass in the sun	88° F.
Leaves of oak tree	81° F.
Soil in the shade of big oak tree	79° F.

This shows that on days with intense solar radiation unshaded surfaces will add heat to the surface layer of air. In contrast, shaded surfaces have temperatures only slightly above air temperature and will not add materially to the air temperature. The example given above is quite conservative. There are cases on record when pavement temperatures of 130° F. and roof temperatures of 170° F. have been measured. These roof temperatures are particularly undesirable for keeping houses comfortable in summer. Tall shade trees mitigate this condition considerably.

The unshaded roof, in general, is a big offender against summer comfort in our homes. There are several remedies available to builders even where shade trees are not in existence. First and foremost are proper reflective and insulating materials under the roof. Next is appropriate ventilation under the roof to avoid a stagnating mass of air in the attic. Here are some figures to illustrate the case:

Outside air temperature under standard meteorological conditions	88° F.
Dark asbestos shingle roof in the sun	122° F.
Temperature just below uninsulated roof	108° F.
Temperature just below insulated roof	97° F.
Air temperature in fan-ventilated, insulated attic	90° F.

In the case of poor ventilation and lack of insulation, the attic temperature is 20° above the air temperature. With appropriate insulation and ventilation this surplus can be kept to only 2°.

Of almost equal importance with the roof for the control of the inside climate of a house are the windows. In most areas of the United States we would like to let as much sunshine as possible into the house in wintertime. In summertime we want to keep as much radiation as possible out of it. For the first purpose, we install large window surfaces on the south or southwest side. We avoid, in most climatic regions, north or northwest windows in order to keep the infiltration from

Fig. 3. A house with its windows equipped for the experiments described in this article.

cold winds to a minimum. For the second purpose, we have to shade the windows because solar radiation, once trapped on the inside of a glass pane, stays. Glass is almost completely impermeable to the long-wave radiation originating indoors. A room heated through glass by solar radiation rapidly acquires temperatures 15° to 20° above air temperature — the well-known greenhouse effect. Blinds on the inside help little. They keep the bright light out but the radiation is trapped behind the window just the same. This is what measurements show:

Outside air temperature under standard meteorological conditions	88° F.
Temperature of unshaded windowpane in the sun	99° F.
Slats of venetian blinds behind window, on room side	96° F.

The remedies for this situation are sufficiently wide awnings, or better yet shutters covered with reflecting paint, when closed (see the door and window on the right of the house in the picture). In this case the temperature readings taken simultaneously with the above figures were:

Windowpane on door behind awning	89° F.
Windowpane on window behind shutter painted white	84° F.

Some people may suggest leaving the windows open. This is generally only a second-order remedy. An open window will let successively warmer air in during the course of the day as the temperature outside rises. If windows, however, are kept open at night to let cool air in but closed and shaded after

sunrise, the indoor air temperature stays generally lower than the maximum outside temperature. In the case described above it was 79° F.

In conclusion, we note that microclimatic investigations are a field full of fun for the amateur weatherman who would like to use his knowledge for comfortable living. Here is the way to proceed. Survey the various climatic differences of your home district compared to official stations in all seasons. Observe differences in plant life, especially dates of first blooming in spring. They offer many useful hints on microclimate. Watch the microclimatic effects of trees, shrubbery, hedges. Note the differences of slopes of various exposures and the differences between hilltops and valleys. Watch the influences of water surfaces. Note the temperature differences of various surfaces. Take readings of temperatures indoors and outdoors in various settings. It is usually easy to turn the knowledge thus gained to advantage for improving the microclimate of your own home. What about equipment? The amateur microclimatologist rarely needs more for a start than a psychrometer and a hand anemometer.

THE HUMIDITY AT 100,000 FEET!

The direct measurement of dewpoint temperatures in the stratosphere is now possible, according to Earl Barrett, of the University of Chicago.

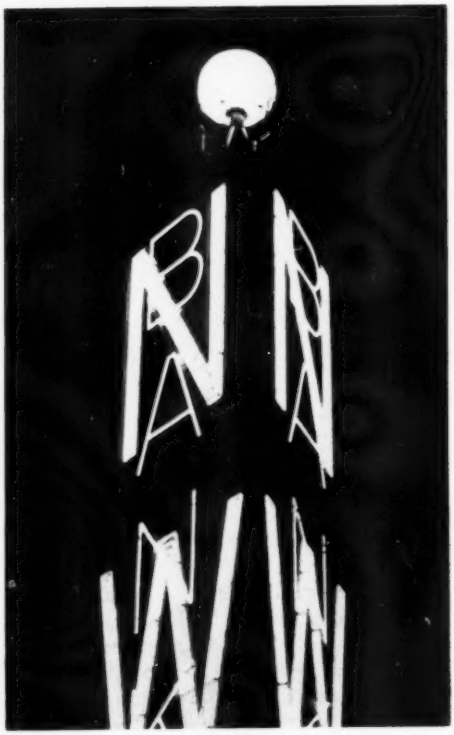
By means of the new Skyhook balloon, developed by the General Mills Company, Mr. Barrett and his associates at the instrument laboratories of the University of Chicago have been able to raise heavy electronic equipment to unprecedented heights. The six flights already accomplished have averaged 100,000 feet. By means of a frostpoint mirror instrument that contains a photoelectric cell, Mr. Barrett has received dewpoint readings from heights where the usual radiosonde is unreliable.

Although results are still tentative until many more soundings are made, initial testings indicate that, contrary to accepted belief, there is considerable water vapor in the stratosphere. If such is the case, it will greatly alter existing ideas concerning incoming solar radiation and light from the stars.

MINNEAPOLIS WEATHERBALL

Residents of Minneapolis and its suburbs can now learn the latest U. S. Weather Bureau forecast by merely glancing in the direction of the tower on the Northwestern National Bank where a new device, the Weatherball, has recently been installed. A 10-foot plastic sphere forecasts tomorrow's weather by means of a color code. If the Weather Bureau releases a prediction for warmer the ball is lighted red; if colder is forecast the ball is white; and if there is to be no change the ball is green. A flickering Weatherball warns that precipitation is coming.

Reportedly seen from an airplane 80 miles away, the sphere is 367 feet above the street, and it is the topmost feature of a 78-ton sign. The sign itself flashes "NW" in 30-foot letters and "BANK" in 13-foot type. The Weatherball has created tremendous interest in weather-conscious Minneapolis, where unusual temperature variations are just a normal occurrence.



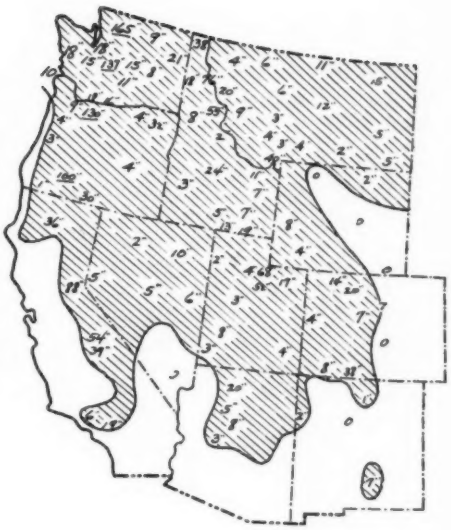
The Weatherball atop the Northwestern National Bank building in Minneapolis, photographed at night. From a height of 367 feet, the Weatherball dominates all buildings and structures in the vicinity.

(Continued from page 2)

tures below normal, had wavered around in the vicinity of Vancouver Island and Puget Sound, and by the night of the 12-13 it lay almost exactly on the Oregon-Washington border, forming the "leading front" on which an intense Pacific cyclone was to approach the coast. By midmorning of the 13th, an intense low was just off the north Oregon coast, with pressure at Tillamook down to 984 millibars (29.06 inches), very low but not a record for the area; and a great blizzard raged all day over and west of the Cascades in Washington. Winds were whole gale from the northeast (with gusts of hurricane force); the temperature was in the teens, and snow up to 20″ covered the region. In the southerly quadrants of this intense low, there were record winds, Redmond, Oregon, reporting 78-mph gusts. Red Bluff at the head of the Sacramento Valley registered the highest wind on record, a mile at 59-mph rate.

In this same two-decade period (January 1-20), precipitation in some amount fell every day but one at Seattle and Spokane, and on every day at Portland, and mostly in the form of snow. At Spokane 38″ fell by the 14th, bringing the season total to 55″, the month to an all-time figure; additional snows there through the 20th continued to swell these astounding figures. Klamath Falls in Oregon, near the California border, had 30″ of snow on the ground after the great storm, and the ridge of the Cascades was buried in over 100″ at every measuring point, topped by 165″ at Mt. Baker Lodge, Washington. The Columbia River gorge, always the scene of winter violence, was subjected to one of its worst sieges of whole gale to hurricane east winds, blinding, drifting snow and bitter cold. These winds, spewing out over Portland, resulted in that city remaining below freezing throughout the 19th, while over two inches of freezing rain and sleet glazed the area, falling through a great warm current aloft that had already raised Seattle's temperature to 40°.

By the 20th, this great northward flow of Pacific balm had engulfed all of the hitherto frigid regions with temperatures near or above 50°, skyrocketing subzero Montana figures as much as 80° within 48 hours. Helena rose from −23° on the 18th to 57° on the 20th,



A chart to show the extensive snowcover in the West following the great storm of January 13, 1950. The depths marked were as of January 15-16, at the time of the greatest extent of the snowcover. Chart by D. C. Cameron.

only 6° short of a January heat record! New January heat records were set at Casper, Wyoming, 53°; Pueblo, Colorado, 75°; and Phoenix, Arizona, 84°, on the 20th. At the same time, the tipping seesaw brought temperatures in the East down to normal or slightly below.

The threat of floods in the Middle West was abated for awhile, but the Wabash River gave trouble during January, and even the Mississippi was the source of many anxious moments. Arkansas seemed under a siege of rain that began late in 1949. In New England, on the other hand, lack of precipitation was causing serious depletion of water supplies. During the passage of one change of weather, winds of gale force were experienced in New Hampshire and Vermont. The ski areas were mostly barren of snow until substantial amounts fell in the high country starting on January 21st. Then two large air masses dominated North America, and precipitation was general along their front extending from Maine to Missouri. At Boston, the snow melted rapidly as temperatures returned to abnormally high levels for the season.

D. C. CAMERON

AMERICAN METEOROLOGICAL SOCIETY

NOTES ON THE 30TH ANNIVERSARY MEETING

THE THIRTIETH ANNIVERSARY meeting of the American Meteorological Society took place in the city of its birth, St. Louis, Missouri, from January 3 to 6, 1950. Among the 500 persons attending several had been present at the organization of the society.

Dr. Charles F. Brooks, secretary of the AMS since its inception, opened the meetings with a historical sketch of the society. During the next days, 74 technical papers were presented, and, in addition, many informal gatherings were held. The highlight of the meeting was the 30th anniversary banquet, with Dr. Francis W. Reichelderfer, Chief, U. S. Weather Bureau, as the principal speaker.

Election of new officers for the society was announced at the annual business meeting. The incoming president is Brig. Gen. Donald Yates, Chief, Air Weather Service, who has long been closely associated with the society's activities. His assistant, in the office of vice-president, will be Joseph J. George, Chief of Meteorology, Eastern Airlines.

Four new councillors were also elected to serve three-year terms: Dr. Sverre Petterssen, Air Weather Service; Ivan Tannehill, U. S. Weather Bureau; Capt. F. A. Berry, U. S. Navy; A. K. Showalter, U. S. Weather Bureau.

An outstanding feature of the technical

Members and guests at the 30th anniversary dinner of the American Me

sessions was the symposium on air pollution and purification, arranged by C. A. Gosline, E. I. du Pont de Nemours & Company. It brought together many leading men not only of meteorology but in private industry and municipal government. For the first time in the society's history there was a full-scale consideration of a very urgent human problem.

The 19 papers presented on this subject ranged from discussion of a condensation nuclei counter for measuring air pollution to the physics of eddy diffusion at the stack. The meteorology of typical air pollution situations was discussed, and a review of the Donora, Pennsylvania, smog disaster was presented. The results of many experimental studies of smoke dispersion were presented by those engaged in atomic research projects.

Industrial leaders emphasized the difficulty in using present day forecasts as an instrument in planning their production schedules. They called for improvement in controlling pollution at the source with better collector equipment and better dispersion methods.

TRANSOSONDE

A call for a new meteorological instrument to sound the atmosphere over large bodies of water was issued by Capt. H. T. Orville, retiring president of the American Meteorological Society, in his address before the society's business meeting. Capt. Orville visualizes the perfection in 10 years time of a balloon-borne multiple radiosonde instrument that would drift across the Atlantic Ocean at a height of 30,000 to 80,000 feet and release a dropsonde type instrument once every six hours. Thus soundings of the atmosphere would be secured approximately every 300 miles across the ocean. For this reason,

American Meteorological Society at the Hotel Jefferson, St. Louis. Photo by Eugene Taylor.

Left to right: Dr. Francis W. Reichelderfer, Chief, USWB; Capt. H. T. Orville, retiring AMS president; and Brig. Gen. Donald Y. Yates, incoming president. Official photo, USAF 3310th Technical Training Wing, Scott Air Force Base, Illinois.

Capt. Orville suggested the name *Transosonde* for the device, and pointed out the potential great saving possible with this approach to the over-water weather observation problem. This brings to mind the great technical success of the Japanese balloon campaign against our Pacific Coast during World War II. Although they were pioneering in this field, the Japanese succeeded in getting 30 per cent of their launchings across the wide expanse of the Pacific, each one carrying a bomb load, which in peacetime might have been automatic weather reporting instruments.

MIDWINTER CLOUDBURST

Many members of the American Meteorological Society witnessed a weather show of unusual proportions. A cold front thunderstorm broke over Scott Air Force Base shortly after noon on January 3rd, as many delegates to the AMS convention were gathering. With the mercury standing at 67° F., a shower of four minutes duration between 12:45 and 12:49 p.m. dropped 0.99 inches of rain. An alert Air Force observer made this measurement with a stick immediately on the conclusion of the downpour. Several tornadoes were reported to the west of the station during this same cold front passage. North of St. Louis, one tornado damaged or destroyed 60 houses along a 10-mile path.

THE METEOROLOGY OF AVALANCHES—I

(Continued from page 6)

shaped slab. If by overweight or melting a chunk breaks off the cornice, it is likely to shatter the wedge and start a slide.

As has been shown, water in any form greatly affects stability. High humidity, particularly in combination with warm temperatures, can lead to avalanche hazard. The moisture of the warm air condenses on the cold surface snow, releasing latent heat and promoting thaw conditions. This condition is exaggerated because the humid air tends to trap heat radiation near the snow surface rather than allowing it to escape.

Low humidity reverses the process. Although dry air at the snow's surface may be above freezing, the evaporation process absorbs heat and keeps the snow cover at a lower temperature.

Rain as well as thaw water lubricates, melts, and, upon freezing, can glue the snow together. Furthermore, rain adds tremendous weight to a snow mass while reducing its cohesion.

Each of the various mountain regions of the country has its most common cause of avalanches, due to climatic conditions. In a future article, some of these regional characteristics will be considered, and methods of studying and forecasting snow and avalanches will be discussed.

WEATHER AND BUILDINGS

A two-day conference on "Weather and the Building Industry" was recently concluded in Washington, D. C. Arranged by the Building Research Advisory Board of the National Research Council, it brought together leading weathermen and builders from all parts of the country. Presentation of papers, panel discussions, and round-table discussions made up the formal part of the program. The titles of the various sessions were: Recent Climatological Research, How Can the Weather Sciences Be Developed for Better Use in the Building Industry?, Climate and Structure, Climate and Design of Buildings, and Climate and Indoor Comfort. WEATHERWISE will carry additional information on this subject during the coming months.

WITH THE RESERVES

RESERVE WEATHER OFFICERS MEET

A gathering of more than 75 weather officers of the U. S. Air Force Reserve was a highlight of the 30th anniversary meeting of the American Meteorological Society. Many of the reservists were flown to St. Louis by Air Weather Service planes as part of the intensive training program now under way.

Lt. Col. Richard Gill, Chief, Reserve Section, Air Weather Service, presided at the meeting and discussed present and future plans for augmenting the reserve training. He discussed both the problems of mobilization assignment personnel and of those attached to corollary units. Col. Gill stated that plans call for a complete duplication of existing regular Air Weather Service facilities, so that the reserves in case of a national emergency could take over all functions of the existing continental weather service.

It was emphasized by Col. Gill that opportunities for 15-day active duty periods are available for all reserve personnel with a mobilization or corollary unit assignment. This duty must be completed before July 1, 1950, and applications should be forwarded immediately to Headquarters, Air Weather Service.

The opportunities for training as Airman were also outlined. Any man between the ages of 17 and 35, physically qualified, who wishes to receive training as a weather observer can be enlisted in the Air Force Reserve despite his lack of previous military experience. Training consists of attendance at the nearest Air Force base for one weekend per month plus an active duty training period of 15 days during the summer. Airmen will be on full-pay status. Members of the Amateur Weathermen of America with the proper qualifications can thus obtain professional training as weather observers, and have the opportunity to work with the latest types of meteorological instruments.

WEATHER TRAINING AVAILABLE FOR ROTC GRADUATES

Comprehensive training in meteorology, commencing in September, 1950, is open for qualified recent Air ROTC graduates. Candidates will attend a graduate school of meteorology on full-pay status for a period of one year and then serve on active duty with the Air Force as weather officers for a period of three years.

Educational requirements are a degree in the physical sciences including courses in calculus through integral calculus and physics through thermodynamics.

A quota of 100 has been established for the training at four locations: Massachusetts Institute of Technology, New York University, University of Chicago, and the University of California at Los Angeles. Those qualified and desirous of training should write immediately to: Chief, Air Weather Service, Andrews Air Force Base, Maryland.

RESERVE AEROLOGY OFFICERS TRAIN

A two-week-long training course for Reserve Aerological Officers was conducted at the Naval Air Station, St. Louis, Missouri, from January 3 to 17, 1950. A total of 125 attended: 100 from the Volunteer Reserve and 25 from the Organized Reserve.

The first days of training were devoted to attendance at the 30th anniversary meeting of the American Meteorological Society. Many of the technical papers presented had direct bearing on naval matters, some of them sponsored by the Aerology Section, others by the Office of Naval Research. The informal sessions also afforded reservists the opportunity of renewing acquaintance with former instructors and fellow students at the meteorological schools, as well as with many former shipmates.

Following the AMS meetings, a solid week of lectures, demonstrations, and exercises on naval aerological problems was presented by the staff of the Aerology Section. Among the subjects were: atomic, biological and chemical warfare, fleet application of weather, hurricane and typhoon reconnaissance, development in the field of atomic warfare and its effect on the field of meteorology, guided missiles and weather radar developments and the use of radar in weather, developments in the field of forecasting, and instrumental developments.

Afternoon sessions were devoted to a discussion of the current weather situation, practice map analysis, and forecasting.

Demonstrations of the new Skyhook balloon and a flight of the Air Weather Service's long range weather reconnaissance planes were scheduled. All officers also visited the plant of McDonald Aircraft.

The success of the training program led Capt. H. T. Orville to express the hope that the program might be repeated next year in conjunction with another meeting of the AMS.

ANTARCTIC WEATHERMEN

The current population of Antarctica consists mainly of penguins and meteorologists. No less than three meteorological expeditions are already there with more on the way. An Australian group is installed at Atlas Cove; a French settlement, at Adelie Land; and a Norwegian expedition with British and Swedish members is installed at Queen Maud Land. Thus, the weather of Antarctica is being more closely watched than ever before, and scientists the world over are looking forward to increased knowledge of this important continent.

FORECASTING THE WEATHER

The Relationship of Temperature and Precipitation over the United States to the Circulation Aloft

DONALD E. MARTIN AND HARRY F. HAWKINS, JR.

EXTENDED FORECAST SECTION, UNITED STATES WEATHER BUREAU

ONE OF THE MAJOR developments in weather forecasting during the past 15 years has been the increased use of prognostic charts. Employment of these charts in routine daily practice at the U. S. Weather Bureau in Washington was first begun by a small group of pioneers in the Air Mass Section, a forerunner of the now well-known U. S. Weather Bureau-Air Force-Navy Weather Central. The trend in meteorological thinking during the past 10 years has been distinctly in the direction of more use of prognostic charts. This statement applies to both short and long range forecasting.

But prognostic charts, as they are prepared today, only contain pressure patterns at the surface or aloft, air masses, and fronts. It is quite clear to those who have attempted to use these charts that the step from prognosis to weather forecasting is not always straightforward. Even if the prognosis were perfect, different forecasters might interpret the patterns differently in terms of concurrent weather. This problem first came into sharp focus in 1940, when in the Weather Bureau's Extended Forecast Section an attempt was made to forecast temperature and precipitation over the country from 5-day mean prognostic charts of pressure at sea level and 10,000 feet. Since that time a good deal of fruitful research on this problem has been done, leading to a reasonably objective method of integrating the pressure pattern prognosis and the temperature and precipitation forecasts. These results, to be discussed in a series of six articles, have application not only to longer period predictions, such as 5-day forecasts, and to synoptic climatology, but also should be of primary concern to the short range forecaster. Indeed, it is hoped that they may point the way to a solution of one of the most pressing questions in the mind of the practicing weather forecaster: What specific weather does a pressure chart indicate?

The first three articles, written by Donald E. Martin, discuss the relationship between surface temperatures in the United States and the 700-millibar pressure patterns for the winter and summer seasons. The next three articles, written by Harry F. Hawkins, Jr., will be concerned with the relationship of winter precipitation to the upper-level circulation.

TEMPERATURE PATTERNS OVER THE EASTERN AND CENTRAL UNITED STATES IN WINTER

IF YOU HAD to choose one location over which the upper-air circulation is the most critical in affecting the temperature over most of the eastern and central United States, where would it be: Bermuda, Labrador, northwestern Canada, or the Gulf of Mexico? The answer is the third-named region, particularly in the area of 60° north, 130° west, near southeastern Alaska at the boundary of the Yukon and British Columbia.

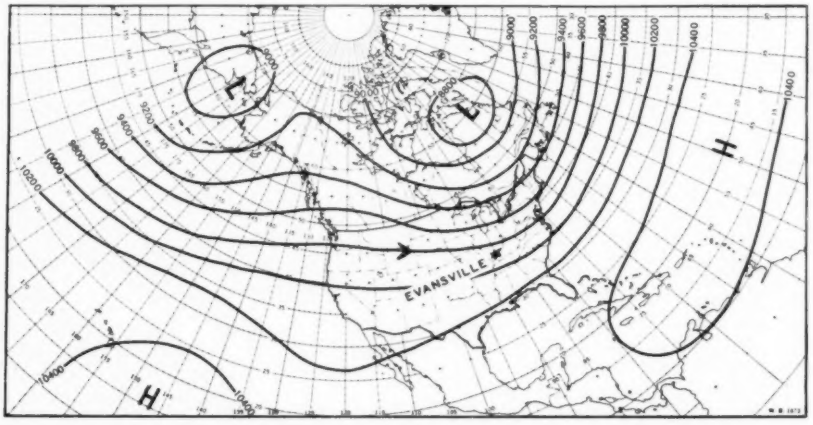


Fig. 1. Normal 700-mb chart for the month of January. The contours represent elevation in feet where the pressure is 700 millibars.

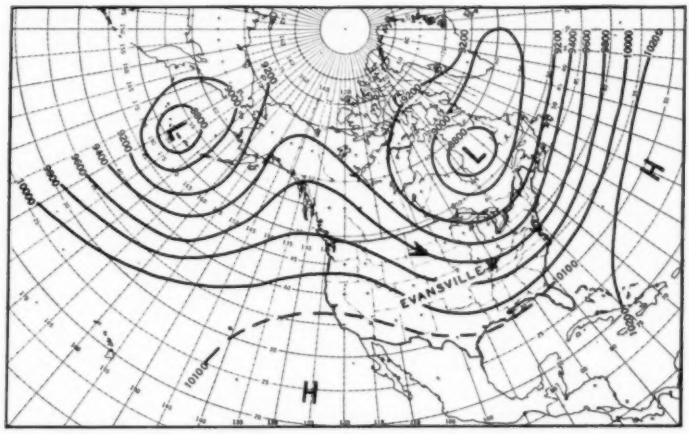


Fig. 2a. Typical 700-mb chart associated with cold surface temperatures at Evansville. Winds blow parallel to contours, as indicated by the arrow.

Let us look, for example, into the temperatures at Evansville, Indiana, as they are indicated by the upper-air patterns at 700 mb. The techniques used for this station are applicable to all stations in the area east of the continental divide. Since a recent poll* of approximately 1,500 American forecasters indicates that the 700-mb pattern is the most popular upper-level chart used in the preparation of forecasts, the surface temperature will be discussed as it is related to this upper-level pattern. This 700-mb level is near enough to the earth's surface to be closely related to surface weather and is usually far enough above to obtain a fairly good picture of the wind flow in the upper levels of the troposphere.

Fig. 1 shows an example of a normal 700-mb pattern obtained by averaging upper-level maps for many Januarys. The lines drawn on this chart represent the average height in feet above sea level where the pressure is 700 mb. This upper-level height above a particular station becomes important in estimating the surface temperature at that station, and similarly a variation in this height is a good measure of the variation in the surface temperature. This is true largely because high elevations of the 700-mb surface are usually associated with expanded air columns between the ground and 700 mb, due in turn to warm temperatures between these levels. These warm temperatures might be considered as resulting in an inflated column of air lifting up the top layer. On the other hand, low heights of the 700-mb surface are usually associated with cold surface temperatures; for cold temperatures in the layer between the ground and 700 mb result in a contracted air column between these levels and, consequently, a lower height of the upper-level surface.

For purposes of illustration, a comparison might be made between the column of air from the ground to 700 mb and the column of mercury in an ordinary thermometer. The top of the mercury column in a thermometer may be

*Elliott, R. D., C. A. Olson, and M. A. Strauss. "Analysis of Replies to a Questionnaire on Forecast Aids," American Meteorological Society **Bulletin**, Vol. 30, No. 9, page 314, Nov. 1949.

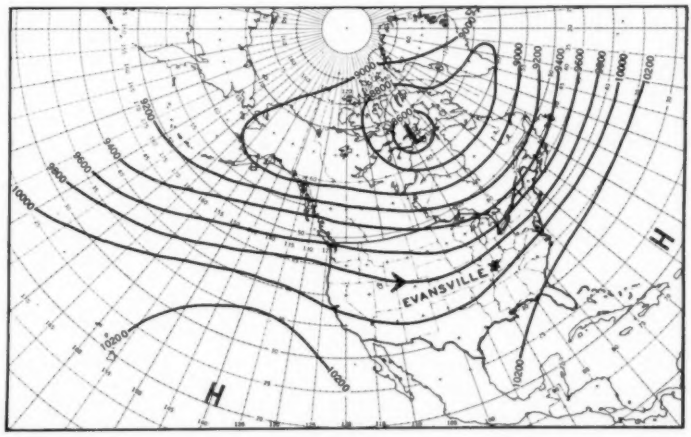


Fig. 2b. Typical 700-mb chart associated with warm surface temperatures at Evansville.

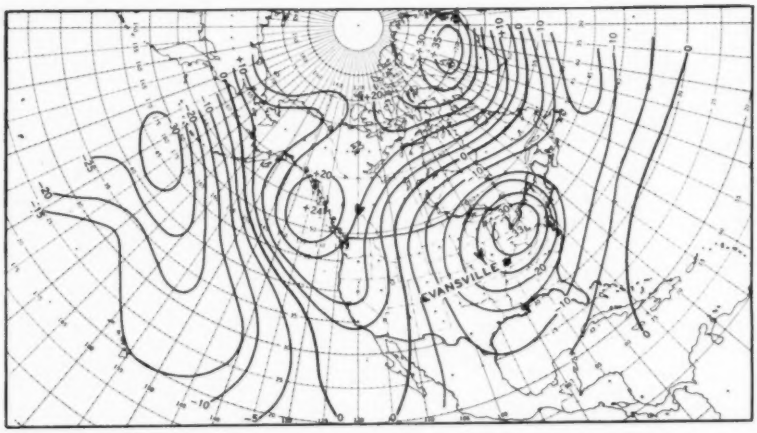


Fig. 3a. 700-mb height departure from normal associated with cold surface temperatures at Evansville. Lines are drawn for every 50 feet and are labeled in tens of feet. The arrows indicate the departure of the wind direction from normal.

considered as being the 700-mb surface and the bottom of the column as being the ground. If a flame were brought close to the thermometer the mercury would expand and the top of the column would become higher. If the surface pressure remains about the same, this would be comparable to warm surface temperatures and the resulting high 700-mb levels. Now, if the flame is removed and a piece of ice is held next to the thermometer, the mercury will shrink and the top of the column will be found much lower. This is comparable to cold surface temperatures and the resulting low 700-mb height.

When the 700-mb surfaces are depressed, low pressure areas are usually associated with them on the corresponding sea-level map. Cloudiness and precipitation prevail and the afternoon maximum temperatures are low, because there is very little sunshine to heat up the earth's surface. When the 700-mb levels are high above the ground, high pressure areas are usually found on the sea-level chart. Here, cloudiness and precipitation are at a minimum, and with an abundance of sunshine the afternoon surface temperatures are found to be relatively high.

In Fig. 2, 700-mb patterns are shown for the case of extreme cold (2a) and extreme warm surface temperatures (2b) at Evansville. A comparison of these patterns shows that the height of the 700-mb surface at Evansville is much greater for the warm map than for the cold one. Also, on the cold map the upper-level winds blowing over Evansville have originated from far northerly latitudes and have a northwesterly direction over the central United States. These winds are carrying cold air from Canada. The winds on the warm pattern, on the other hand, are from a more westerly direction and bringing warm Pacific air to Evansville; these westerly winds effectively prevent the influx of any very cold Canadian air.

By subtracting the normal map from such maps as Fig. 2, we obtain lines of departure from normal as shown in Fig. 3. This simple procedure is a good way of making a comparison between any given upper-level pattern and the normal pattern for that season of the year. It can readily be seen that the 700-mb heights at

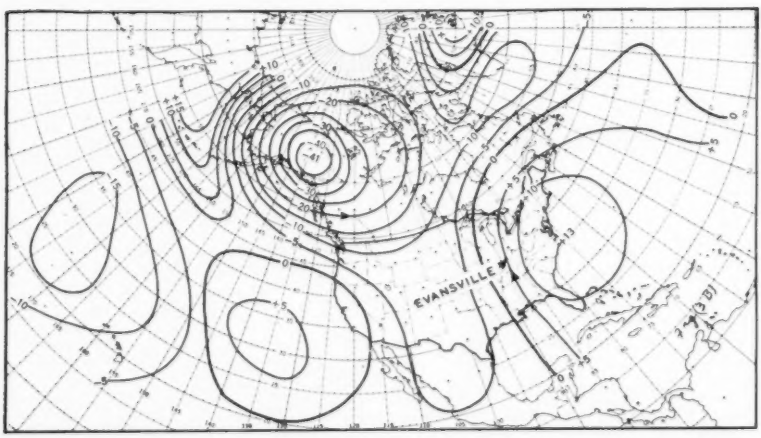


Fig. 3b. 700-mb height departures from normal associated with warm surface temperatures at Evansville.

Evansville are lower than the seasonal normal for cold weather and higher than normal for warm. A closer comparison of these charts shows that in some areas one chart is quite opposite to the other chart. These opposing areas appear to be highly important in forecasting the surface temperature at Evansville. The lines of equal height anomaly may be considered a measure of the manner in which the wind direction departs from the normal. In the case where cold temperatures are found at Evansville the upper-level winds are more northerly than normal, and in the pattern for warm temperatures the upper-level winds are more southerly. This deviation of the wind direction from normal, together with the height of the 700-mb surface overhead, is clearly important in determining the temperature at a station.

To return to the question of the opposing anomalies of Fig. 3: In northwestern Canada the height of the 700-mb surface has a considerable departure from the normal on each of the patterns in Fig. 3, but the two departures are opposite in sign. Above normal heights appear here on the cold circulation pattern and below normal heights on the warm. The 700-mb contours in this area, northwestern Canada and southeastern Alaska, are extremely important in determining the surface temperatures for stations located many thousands of miles away. In fact, this region might be compared with a control valve or floodgate, since it appears to determine the amount of cold or warm air permitted to invade the United States. When the ridge in northwestern Canada is stronger than the normal ridge located in this area and extends to far northern latitudes, the valve is open — cold polar air pours into the central and eastern United States. Northerly winds with freezing temperatures and blizzards frequently invade our country. The intensity and duration of each cold spell depends in large part upon the intensity and duration of the abnormal ridge in Canada.

When 700-mb heights in this critical area of Canada are much lower than normal, the opposite is true; the valve has been closed. Cold air is not permitted to enter the United States, for as the normal ridge in Canada becomes weaker the northerly flow of air into the United States is halted. Westerly winds appear along the Canadian border, bringing only warm Pacific air masses, while the cold air is concentrated north of the border. In these cases the United States is bathed in mild springlike weather for as long as the Canadian ridge remains weak or nonexistent.

Thus we begin to appreciate the importance of a widespread network of weather observations. Reports from Canada, for instance, are as important to the man forecasting the temperature in Evansville as are observations in that city itself.

Statistical procedures have been used to find more details about the optimum area in northwestern Canada which must be considered in making temperature forecasts for other stations in the eastern and central United States besides Evansville. In each case the location was found along 60° north latitude at about 130° west longitude. As we have seen, the height of the 700-mb surface in this area is as important in relating the surface temperature to the 700-mb pattern as is the height of the 700-mb surface at or near the station.

A simple method may be employed using the 700-mb heights in these two areas. To do this the surface temperature is analyzed graphically as a function of the height of the 700-mb surface in northwestern Canada and at the station (Fig.

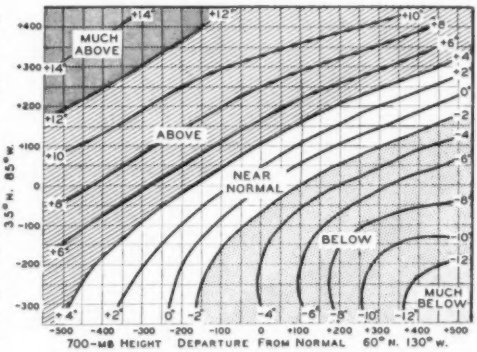


Fig. 4. A graph for forecasting surface temperature anomaly at Evansville, Indiana, from the 700-mb 5-day mean height anomaly. Ordinate (vertical scale) is the departure from normal in feet at 35° north, 85° west. Abscissa (horizontal scale) is the departure from normal in feet at 60° north, 130° west.

4). The lines on this chart represent equal values of surface temperature departure from normal. Shaded areas on the graph show the various classes of temperature anomalies often used in forecasting. Much above normal temperatures appear when the 700-mb heights at the station are far above normal at the same time that heights in northwestern Canada are far below normal. Conversely, much below normal temperatures are found when the 700-mb heights at the station are far below normal at the same time that heights in northwestern Canada are far above normal. Thus, in order to get extreme temperatures both of these factors must operate in the proper direction.

Since the slope of the lines of equal temperature anomaly in Fig. 4 is approximately 45 degrees, both factors are of nearly equal importance in their relation to surface temperatures at Evansville. Therefore, a good estimate of the surface temperature can be made by forecasting the relative magnitudes of the two factors, even though the exact values at these points are in error. Forecasters know that a forecast of the overall pattern is easier than the forecast of absolute values at a specific point.

WORKSHOP FOR WEATHERMEN

CONDUCTED BY CHARLES A. LAIRD

How to Construct a Barograph

THE BAROGRAPH or recording barometer, if properly constructed, will give a continuous record of fluctuations in atmospheric pressure and provide an interesting and important graph of pressure changes for the amateur weatherman.

In order to construct the barograph shown here, it will be necessary for you to find an aneroid (all-metal) barometer of the "watch case" type. You may be able to find one of these in a secondhand store, or if you are interested enough in building a barograph, you may buy one of the lower-priced aneroid barometers.

The barograph itself is built on a wooden base. The rotating chart cylinder, around which is wrapped the chart, consists of a metal can 4" in diameter and 4" high. It is best that there be a flange at the lower end of the cylinder for the chart paper to rest on. (This is shown in the drawings.)

You may construct the device so the chart rotates once a day or once a week, depending upon the speed ratio you use. As illustrated, a small wheel is mounted on the hour staff of the clock and the chart cylinder rests on it and is rotated by it. The ratio should be in accordance with whatever chart speed you wish to use. Try to find an 8-day clock if you can, although a 24-hour alarm clock will do, but you will have to wind it more often. Cut a slot in the baseboard of the barograph so the clock will rest in it, and clamp it with a brass strip held by two screws.

Remove the aneroid movement from the barometer case and mount the brass base plate (which will be about 4" in diameter in most barometers) on the wood barograph base with wood screws. The short upright post and arm supporting the small pulley, hairspring, staff, and pointer should be removed from the brass base plate. An upright post consisting of ⅜" round brass stock should be mounted on the brass base plate, as shown in both drawings. To the top of it is fastened a horizontal brass strip, bent at 90° angles at the ends and drilled and tapped for 4-40 pointed pivot screws.

A shaft consisting of a section of ⅛" round brass stock is used as the pen arm axis. A small round piece of brass shafting is clamped in a hole drilled in the pen arm axis in such a position that it is immediately above the long arm projecting from the aneroid barometer spring. It is clamped in the axis with a set screw, as shown in the drawings, so that its length may be varied, and thus the barograph may be calibrated.

A link made of very thin sheet metal connects this to the arm, which is fastened to the barometer spring above the pressure cell. This arm and the short variable shaft are slotted, and small pins (you may use needle points) project through small holes drilled in the link. The pivot screws supporting the pen arm axis should be above the base at a height equal to the center of the chart cylinder (about 2").

Make the pen arm of thin sheet metal and fasten it with small bolts to a horizontal brass strip soldered to the pen arm axis. A counterweight which almost balances the weight of the pen arm should be used. This is shown in Fig. 1.

You may use a section of brass rod about 1/16" in diameter, mounted on a horizontal pivoted brass strip, as a "lifter" to push the pen arm and pen away from the cylinder when changing charts. The pen itself consists of a simple pointed trough which may be filled with a mixture of half writing ink and half glycerine. Or you can use an ordinary crow quill pen-point. The pressure of the pen against the paper should be very light.

Paper charts may be ruled horizontally in

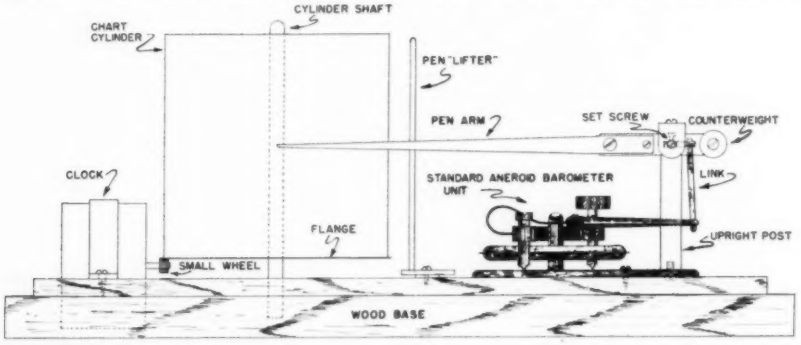


Fig. 1. A side view of the barograph, reduced to one-third the original scale. The cylinder shaft is of ¼" shafting forced into the hole of the wooden base.

inches and tenths, and you can use as many hour lines as you wish. These, of course, should have a curvature to correspond with the length of the pen arm. A small hole should be drilled through the wood base so that a screwdriver may be used to adjust the pressure setting screw of the barograph. Or you can use a large screw with a knurled head, as shown in the drawing.

You will need to calibrate this barograph by comparing its readings with those of an aneroid or mercurial barometer over a period of time and adjusting the small brass shaft.

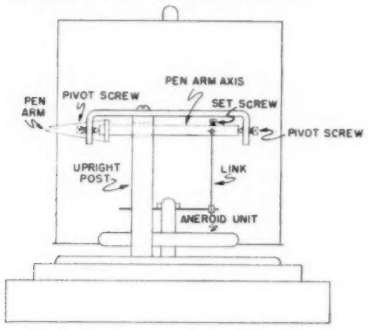


Fig. 2. An end view of the barograph. The upright support post is drilled and the pen arm passes through it. The counterweight on the near end of the pen arm is not shown, for clarity.

WINDIKATOR

wind direction

wind velocity—

at a glance!

Here's a chance for every amateur weatherman to add to the accuracy of his hobby! WINDIKATOR — a *precision-built*, pocket-size anemometer — gives exact wind direction, wind velocity at a glance!

Non-magnetic, rust and corrosion resistant, WINDIKATOR is guaranteed accurate. $8.75. Leather belt carrying case $1.50. Model A indicates velocity 5-30 MPH. Model B, 10-60. If your dealer can't supply you, write Dep't. W-20 . . .

The WINDIKATOR COMPANY

120 Tremont St. Boston 8, Mass.

Export Division: 15 Moore St., New York 4, N.Y.
Cable Address: "Minthorne"

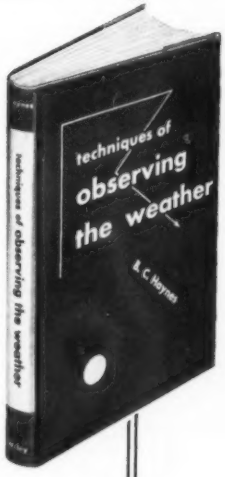
Readable, scientifically accurate facts every weather watcher wants

TECHNIQUES OF OBSERVING THE WEATHER

By Benarthur C. Haynes

Of the many favorable comments we have received on *Techniques of Observing the Weather*, we think the following excerpts from a review in *U. S. Air Services* describe Mr. Haynes' book very well.

"This is a manual of observational procedures that makes weather recording so simple even a child can understand it . . . From it you learn not only how to record the weather, but many pertinent facts about the weather to be recorded, and also about the instruments that supply the material for the record. Observations, both surface and aloft, are dealt with, and by the time you reach the back cover you feel as ready to estimate the speed and direction of a cirrus cloud as you do to manufacture your own instruments for determining air pressure and temperature in your own back yard."



1947 272 pages, illus. $4.00

Copies obtainable on approval for 10-days' examination.

Send for your copy today.

JOHN WILEY & SONS, INC. Dept. W-2-50, 440 Fourth Ave. New York 16, New York

THE CLIMATIC HANDBOOK FOR WASHINGTON, D. C.

Weather Bureau Technical Paper No. 8, U. S. Government Printing Office, Washington, D. C., 1949. 235 pages. $1.00.

THE CLIMATIC HANDBOOK for Washington, D. C., is unique in American meteorological literature in that it includes in one volume an enormous quantity of climatic data for Washington, D. C., covering a period of years (75 in most cases) sufficiently long to be considered climatically significant. This makes easily accessible all the information needed for many diversified meteorological and climatological studies.

In fact, included in the book's 137 tables, 79 pages of charts, and 30 pages of text, are the results of a wide variety of statistical analyses of the Washington records. This furnishes without further study information on means, frequency distribution, extremes, most likely range (which includes exactly 50 per cent of the event for the period of record) and variability expressed as standard deviation.

It is impossible to list here all of the many widely varied types of climatic information that the **Handbook** makes readily available in tabular and graphic form. Noteworthy because of their absence from many other works of this type are the following:

1. Expectancy diagrams giving the extremes and the most likely range of values for many different problems concerning temperature, precipitation, sky cover and sunshine, temperature-precipitation relations, wind, humidity, fog, and thunderstorms.

2. Charts showing persistency and duration of rainy spells, warm spells, cold spells, and the like.

3. Twenty-four pages of text devoted to description of unusual or extreme meteorological events. These are accompanied by 35 excellent photographs of the effects of the above events on the city.

4. Monthly mean sea-level pressure charts covering certain periods of abnormal temperature and precipitation at Washington, D. C. Included also are daily synoptic weather maps for certain similarly abnormal periods.

5. A good discussion in the text of degree days of heating and of cooling, supplemented with complete data and several charts giving complete records for Washington on these subjects.

In the introduction, it is stated, "It is not expected that this publication will provide the complete solution of all individual problems in which climate and weather affect human activity." Indeed, the absence of daily records of temperature and precipitation alone makes the **Handbook** unusable for certain types of climatological studies. This shortcoming prompts the suggestion that future effort and money might well be spent on the task of placing as much as possible of our past climatic data on punch cards. This has been done thus far for only a few years before and after World War II. The period of years involved cannot be considered climatically significant, and therefore it would be highly desirable to have punch card records covering a long period to be climatically useful. Once this were accomplished, practically any imaginable climatic study (including all of those in the present volume) could be worked out quickly and easily by the I.B.M. electronic calculators of the Weather Bureau's Data Control Unit at New Orleans.

The term "most likely range" as it is used in the expectancy diagrams is interesting, because it refers to the smallest range that includes exactly 50 per cent of the data for the period under study. This is the same quantity that V. Conrad and others have defined statistically as the probable error from the mean. The limits thus defined are usually taken as the "normal" limits of the element or quantity under consideration. However, in view of the frequent misuse of the term "normal" in place of the mean, the term "most likely range" is doubtless very well chosen.

Although their inclusion in a volume of this type seems rather peculiar, five pages of world weather data are to be found among the tables. Also present are 14 pages of upper-air data, and information on a wide variety of subjects ranging from ragweed pollen counts for the hay fever sufferer to frost data for the farmer.

A. VAUGHAN HAVENS
Instructor in Meteorology
Rutgers University

Keep Up With the Weather

Read *Weatherwatch*

A daily chronology of weather events in the United States — includes maps and charts of monthly temperature and precipitation. Here are six pages full of exciting weather news.

WEATHERWATCH is sent as a privilege of membership to all members of the AWA. Individual subscription is $1.25 for 12 monthly issues

AMATEUR WEATHERMEN OF AMERICA

Send today for a free sample copy.

The Franklin Institute, Philadelphia 3, Pa.

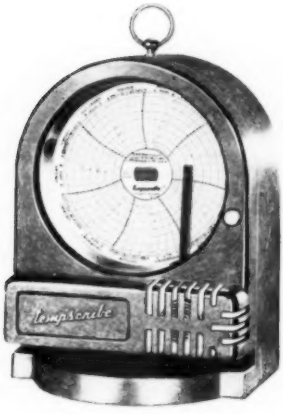
Weather Recorders

Low in Cost - High in Performance

351 BAROSCRIBE — A low-cost recording barometer designed to fill the needs of industrial laboratories, schools, and home weather stations. The Baroscribe employs a precision aneroid cell that is compensated for temperature changes. A sensitive multiplying system connects the aneroid mechanism to a pen arm which traces a sharp record of every barometric variation. A circular chart, 4 inches in diameter, is driven by a spring-wound clock. Recording period is seven days. Barometric range in two models: 28.0 to 31.0 inches and 28.9 to 30.6 inches. Specify range and height above sea level when ordering.

Size: 4½ x 5½ x 7½ inches. Weight 3 lbs. **$58.00**

351



152

152 TEMPSCRIBE — This compact thermograph will meet a great variety of requirements for low-cost temperature recording. The Tempscribe employs a bimetallic coil which has a quick thermal responsiveness. Proper ventilation of the temperature-sensitive element is provided by a special grill. The slightest change in temperature is transmitted directly to a pen arm which records on a circular chart, four inches in diameter, driven by a spring-wound clock. Recording period is either one or seven days; specify which. Temperature ranges: −30° to +120° F.; −10° to +50° F.; or +40° to +100° F.; specify which. Complete with pen, ink, and two years' supply of charts. Size: 4½ x 5½ x 7½ inches. Weight 3 lbs. **$44.00**

153 TEMPSCRIBE (Remote Reading) — Same as #152 except that the temperature-sensitive coil has a special capillary tube for remote recording of temperature. Recorder may be indoors and the temperature element out-of-doors. **$44.00**

Science Associates

401 North Broad Street **Philadelphia 8, Pa.**

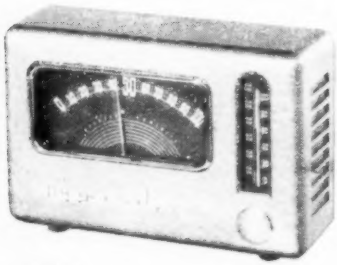
Symbol and Source

of America's foremost weather instruments

BENDIX-FRIEZ

Hygro-dial

Precision Humidity and Temperature Indicator. Hair-operated and calibrated to professional standards of accuracy by the maker of the world's finest weather instruments. Handsome, modern case—4″ high, 5½″ wide, 1⅝″ deep—desk or wall mounting.



A Genuine Precision Indicator Reasonably Priced

WRITE:

FRIEZ INSTRUMENT DIVISION of

1302 Taylor Avenue, Baltimore 4, Maryland

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Bendix AVIATION CORPORATION